40

Critical Path Method (CPM)

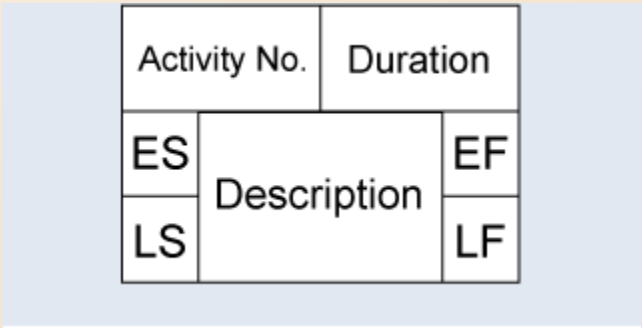
- Used on complex projects, where the relationship and interdependency of the individual construction activities.
- Every CPM schedule will have at least one path through the network, which controls the overall project duration.

Critical Path Method (CPM)

- This path represents the route of longest combined duration through the diagram.
- The route is referred to as the "critical path," since any delay in a construction activity on the path will result in an increase of the project's overall duration.
- For those activities not on the critical path, there exists some amount of flexibility as to when each one can start or finish without affecting the overall project duration. This flexibility is known as “float”, and can be calculated for each activity.

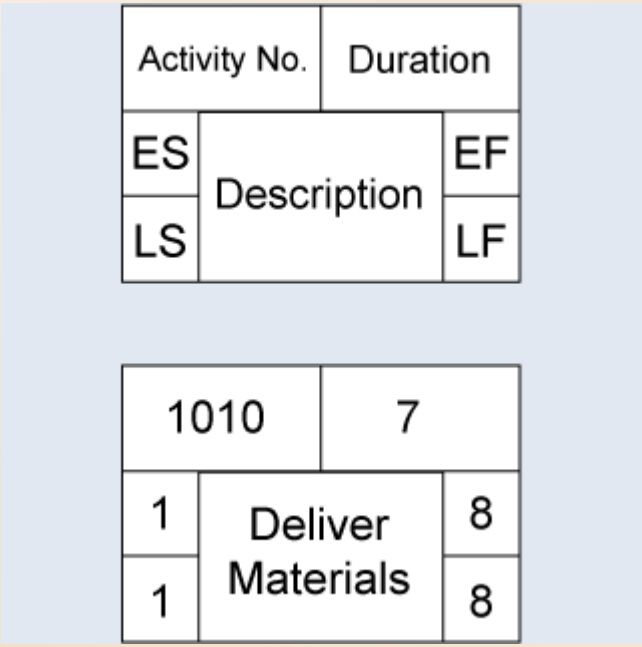
Critical Path Method (CPM)

Principle One:
Activities shown in boxes (node)



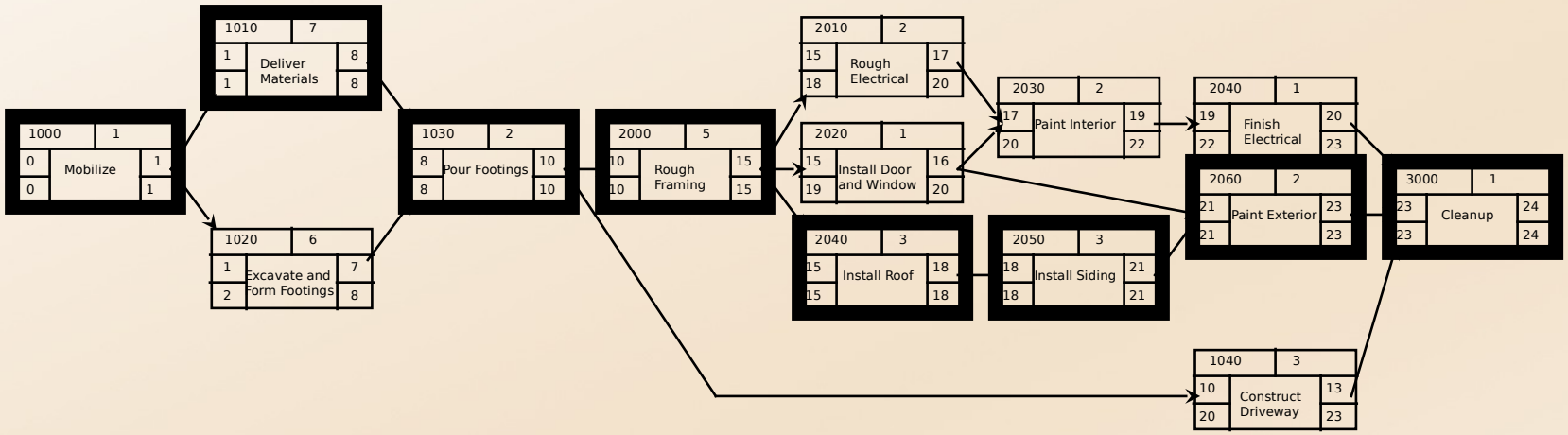
Critical Path Method (CPM)

Principle Two:
All future activity depends on completion of all preceding activities



Critical Path Method (CPM)

Principle three:
All activities begin and end at a desribable point in time



CPM Network Calculations

- CPM provides the ability to determine:
  - Earliest date of project completion;
  - Latest date of project completion if there are no changes;
  - Impact on the project completion date of delaying a specific activity;
  - Critical activities for completing the project on or before the completion date;

CPM Network Calculations

- Process:
  - Perform a Forward Pass
  - Perform a Backward Pass
  - Calculate Total Float for each activity
  - Calculate Free Float
  - Identify the Critical Path

Forward Pass

- **Forward Pass (beginning to end; L=>R)**
  - **Determines duration of project**
  - **Start time of the project is Day Zero (0).**
  - **Early Finish time of each task is its Early Start time plus its estimated duration.**
  - **Early Start time of tasks is the Early Finish of the immediate preceding task.**
  - **Events having more then one predecessor task occur when ALL predecessor dependencies have been met.**

Forward Pass

- **Early Finish = Early Start + Duration**
  - **EF = ES + DUR**

Backward Pass

- **Backward Pass (end to beginning; R=>L)**
  - **Determines critical path & float activities**
  - **Project Late Finish time is taken from the Forward Pass calculation of the project Early Finish time.**
  - **Task Late Start time is calculated by subtracting estimated task duration from Late Finish time.**
  - **The Late Finish time of each predecessor task is the Late Start of its immediate successor task.**
  - **Activities having more than one successor task must occur soon enough to meet all successor dependencies by Project Late Finish time.**

Backward Pass

- **Late Start = Late Finish - Duration**
  - **LS = LF - DUR**

Float

- **Float**
- **FLOAT = Late Finish – Early Finish**
- **Float (or slack) is the amount of time that an individual schedule activity can be delayed without delaying the project finish date.**

Float

- **Total Float = Late Start - Early Start**
  - **TF = LS - ES**

- **Free Float = Early Start (Next Activity) - Early Finish**
  - **FF(x) = ES(x+1) - EF(x)**

The Critical Path

- **The Critical Path:**
  - **Identifying the Critical Path**
    - **The series of schedule activities that determines the duration of the project.**
    - **Generally, the longest path through the project.**
    - **Usually defined by the schedule activities with zero float (critical path activities).**

Actions to Shorten the Critical Path

- **Schedule Compression Techniques**
  - **Fast Tracking**
    - »**Planning and/or overlapping sequential activities to be performed in parallel.**
  - **Crashing**
    - »**Analyzing cost and schedule trade-offs to achieve reductions in schedule activity durations**
    - »**Generally requires additional resources and person-hours**
    - »**Increases costs**
    - »**Must produce a shorter critical path to be visible (non-critical path activities can be crashed, but may not provide an overall benefit).**

CPM Advantages

Advantages: (complex projects)

- **Accepted as evidence in court**
- **Shows high degree of task interdependence**
- **Shows cause & effect, impact & delay**
- **Separate float time and critical activities**